WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: CO261

Title: Use of Low-Cost Data to Simulate Fractured-Aquifer Watersheds for Management of Water Quality and Quantity

Focus Categories: Water Use, Non Point Pollution

Keywords: water quality, water quantity, planning, management, basin scale, fractured aquifer, ground-water

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Federal Funds Requested: $120,000

Non-Federal Matching Funds Requested: $120,598

Congressional District: 6th District

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Abstract

Mountain watersheds are primary water resources in the western United States, but we lack a scientific basis for making credible decisions regarding mountain land use. The rapid growth of population and development in mountain watersheds caused Jefferson County of Colorado to begin collecting data in a pilot study of ground-water resources in the Turkey Creek Watershed, a fractured-crystalline rock aquifer, typical of those that support individual domestic wells and sewage disposal systems for residents of the county and similar areas throughout Rocky Mountains, United States, and the world. A number of agencies funded data collection in the watershed, but the data are in different forms at many locations and have not been integrated into a model for a management tool. Although a ground-water model of the watershed is not expected to predict conditions in a particular well, it can provide information about future conditions in specific areas of the watershed. The proposed research utilizes a rare database from the watershed to complement and extend the work of the USGS by integrating data from many sources and developing models to: 1) better understand the flow system, 2) determine which low-cost data are instrumental in describing the system and which data reduce uncertainty, and 3) simulate the impacts of alternative development scenarios on ground-water levels, quality, and its to the total maximum daily load in streams. The value of the low-cost data value will be confirmed using the more unusual data. The methods developed in this research will be useful for assessing the effects of population growth and development in other fractured-aquifer watersheds.

The most difficult portion of this task is evaluating the fracture character of the aquifer. At this time, society cannot afford to characterize every detail of the subsurface water-bearing fractures to manage

ground water. This project will use an elaborate database to determine the value of low-cost, holistic measures for evaluating the character of three-dimensional fracture flow and the scale at which equivalent porous media models can be used to predict impacts of management scenarios. Before collecting additional field data, modeling studies can glean information from existing data and determine which data will decrease uncertainty. Professors and students will work with USGS scientists, Jefferson County staff, USEPA and other interested parties to 1) compile and organize available data in a manner that will facilitate its dissemination; 2) evaluate the data by viewing their distribution from a variety of perspectives; 3) utilize the data to develop synthetic equivalent-porous-media and fracture flow models, with characteristics of the Turkey Creek aquifer, to create guidelines delineating the use of inexpensive holistic data for comparison with field observations and estimate the scale at which Turkey Creek Watershed can be represented as equivalent porous media; 4) use results of task 3 to generate models of Turkey Creek Watershed applicable to the management scale, calibrate the models using multiple regression techniques, identify the low-cost data that are instrumental in describing the flow system, as well as, the type and location of new data that will improve the calibration or confirm the value of the low-cost data; 5) collect data identified in task 4 and incorporate the data into the model calibration to modify and improve the representative models; 6) predict the impact, and associated uncertainty, for one scenario of increased development on the quantity and quality of water resources; 7) identify the low-cost data that are instrumental in making accurate predictions and evaluate the type and location of new data that would reduce prediction uncertainty or confirm the value of the low cost data; and 8) prepare a report and provide the project findings to the public, while 9) training future Geological Engineers.